
Space Weather Technical Forecast

Issued on Saturday, 02 July 2022 at 13:30 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Active electron fluence continuing. Very slight chance of M-class flares. Chance of G1/Minor Storm conditions on Day 3 or 4.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low over the past 24 hours, with no significant flares observed. There are currently six sunspot regions on the visible disc. The largest region, AR3046 (Hsx/Alpha) in the far northeast is a simple, inactive region at this time. AR3040 (Cso/Beta-gamma) in the far southwest has decayed somewhat, but with some minor spots of opposite polarity in the trailer portion of the group. All other regions are simple bipolar or unipolar regions. No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed has been on a slow, steady decline during the period, from 360km/s to around 330km/s. Density steadily increased during the UTC day on the 1st July, increasing from average to above average levels, with a peak of 41 ppcc at 01/2254 UTC. Thereafter an erratic drop to average density (with a short-lived drop to below average) was observed. The sequence appears to represent the arrival of a slow CME. This assumption is supported by a gradual increase in the magnetic field strength from weak to moderate and a change in the Bz component from weakly positive to moderately negative, with a peak of -13nT at 02/0403UTC. From around 02/1100 UTC the Bz became positive again. The Phi angle was mostly negative (towards the sun) but rotated into the positive (away from sun) sector from around 01/2300 UTC. Thereafter a smooth field rotation was observed with the phi angle becoming negative from around 02/0400 UTC. Resultant geomagnetic activity was initially Quiet (Kp1), but became generally Unsettled to Active (Kp3-4) from 01/1800 UTC onwards, with a G1/Minor Storm interval 02/0300-0600 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) as measured by GOES16 remained at background levels throughout the period. The high energy electron flux (greater than 2MeV) was initially at high levels (with a peak of 6970pfu at 01/1720 UTC) after which, the electron counts reduced to mainly background levels, with occasional moderate periods. This resulted from the CME arrival suppressing the Van Allen belts. Electron fluence was above the Active (1e8 integrated pfu) threshold with an increasing then decreasing trend. An observed fluence of 2.62e8 integrated pfu was recorded at 02/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low or Very Low, with a very slight chance of Moderate activity.

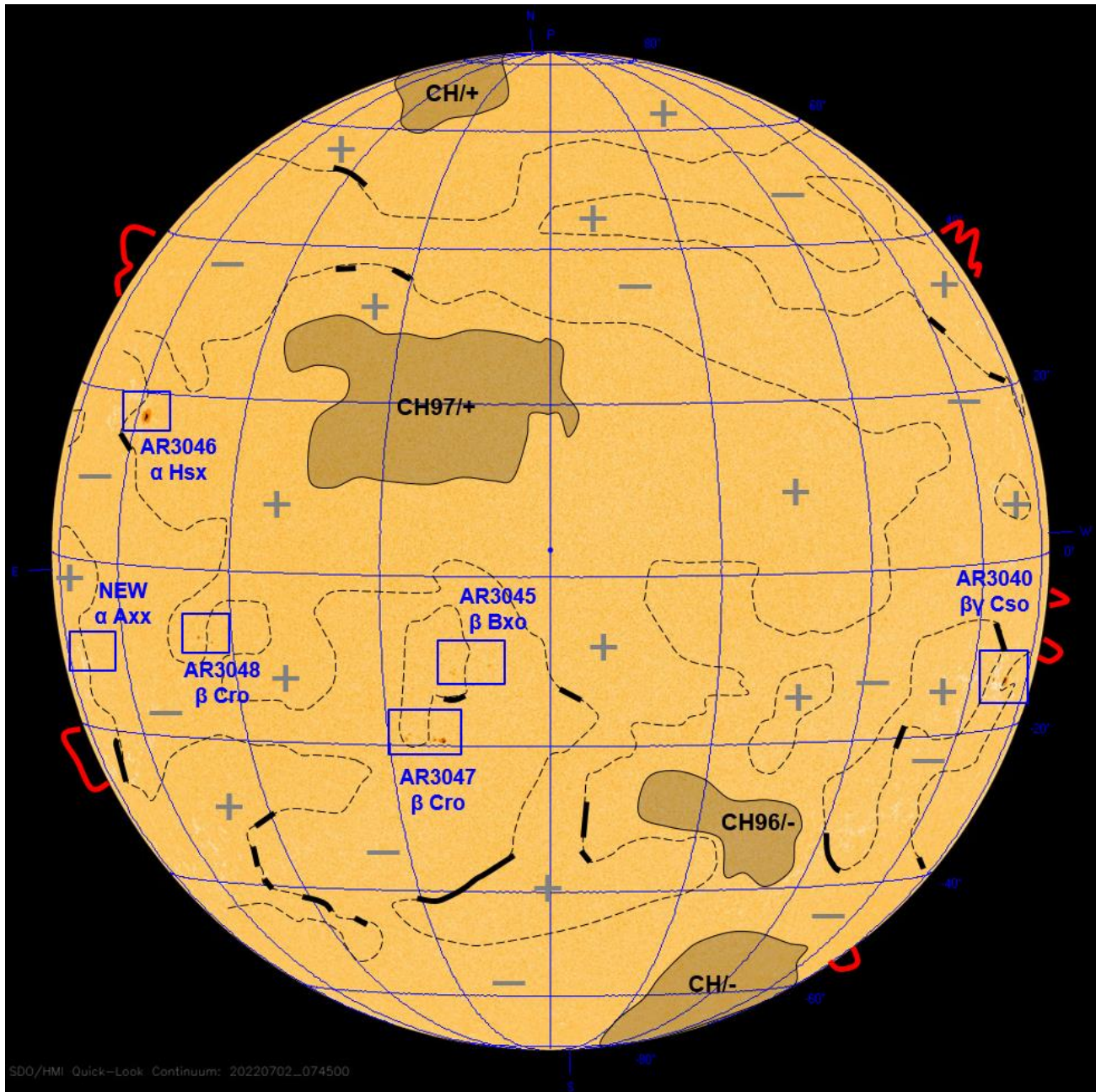
Solar Wind / Geomagnetic Activity: Subsiding geomagnetic effects are currently being observed following the arrival of the CME on the 1st July, though activity could increase again for a time if any prolonged period of negative Bz is observed. A further weak CME may also arrive later on the 2nd July (Day 1). There is the possibility of another CME arrival from the 29th June, to arrive either late on 4th July (Day 3) into the 5th July (Day 4), though again, this is expected to be a weak feature with limited increase in solar wind, which is presently at background levels.

Although in a background solar wind regime at present, one or more high speed streams from coronal holes are likely to affect Earth in the coming days. The most notable being a large coronal hole in the northern hemisphere, expected to arrive either on the 5th or 6th July.

Geomagnetic activity is forecast to be largely Quiet to Unsettled on Days 1 and 2, with a chance of isolated Active intervals, mainly Day 1. Thereafter, activity should increase to Unsettled to Active during Day 3, with a chance of G1/Minor Storm conditions, mainly on Day 4.

Energetic Particles / Solar Radiation: In the absence of any significant sunspot development, the high energy proton flux (greater than 10 MeV) is expected to remain at background levels. The high energy electron flux (greater than 2MeV) has been substantially lowered to background levels due to the CME arrival on the 1st July. Electron counts may recover to become high at diurnal maxima on days 2 to 4 (3rd to 5th July), though may be suppressed again in the case of the arrival of any CME or HSS from CH96/-. Thereafter, Day 4 could see a substantial lowering in electron accounts, with the possible arrival of the HSS from the much larger CH97/+. Electron fluence values, though initially above the Active ($1e8$ integrated pfu) threshold, are expected to fall below by the start of the 3rd July and very likely remain below over the following days due to CME and/or HSS impacts.

Figure 1. Solar Analysis Valid 02/0745 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

Subsiding geomagnetic effects are currently being observed following the arrival of the CME on the 1st July, though smooth rotations in the magnetic field of the CME could still see activity increasing again if any prolonged period of negative Bz is observed. A further weak CME may also arrive later on the 2nd July (Day 1). There is the possibility of another CME arrival from the 29th June, to arrive either late on 4th July (Day 3) into the 5th July (Day 4), though again, this is expected to be a weak feature with limited increase in solar wind, which is presently at background levels.

CH96/- in the southern hemisphere may connect with Earth around the 4th July, though confidence in timings and solar winds to be observed are low, given it is not a recurrent feature. STEREO A has encountered a change in environment around 02/0240 UTC, though it is unclear if this is linked to the coronal hole or a CME.

Perhaps more significantly a northern hemispheric coronal hole (CH97/+) is likely to connect with Earth at the end of the forecast period. Again, this is not a recurrent feature from the previous rotation and is substantially larger and well defined compared to CH96/-. Expected solar wind speeds are uncertain until STEREO A becomes connected with this feature approximately two days before Earth. Arrival times of somewhere between the 5th and 6th July are forecast, with uncertain geomagnetic impacts.

Geomagnetic activity is forecast to be largely Quiet to Unsettled on Days 1 and 2, with a chance of isolated Active intervals, mainly Day 1. Thereafter, activity should increase to Unsettled to Active during Day 3, with a chance of G1/Minor Storm conditions, mainly on Day 4.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	5	5	20	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X-Ray Flares:

There are currently six sunspots on the Earth-facing disc, five of which are presently numbered. The largest region AR3046 in the far northeast is a simple, inactive Hsx/Alpha group. AR3040 near the western limb appears to have decayed slightly with only a minor spot on the trailer portion of the group, but there are a number of minor spots of opposite polarity in the east. This has been reclassified as a Cso/Beta-gamma group. AR3045 (Bxo/Beta) has largely faded, though now contains two small spots without penumbra. Newly numbered AR3047 to the south of AR3045 (Cro/Beta) has demonstrated modest growth, with rudimentary penumbra on the lead portion of the group and some weak intermediate and trailer spots. Similarly AR3048 is also a Cro/Beta group with slight growth. A new, unnumbered region is rotating over the eastern limb. At present it is rather foreshortened in available imagery but a tentative assessment of Axx/Alpha is given to this group.

AR3040 will rotate over the western limb of the visible disc in the next two to three days. STEREO-A EUVI imagery suggests one or more bright regions (that may contain sunspots) will rotate onto the Earth-facing disc in the coming days. This could supplement the risk of significant flares as AR3040 departs.

Solar activity is expected to be Low or Very Low, with a very slight chance of M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels, and will most likely remain at this level through the period, in the absence of any significant sunspot development.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

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High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2MeV) has been substantially lowered to background levels due to the CME arrival on the 1st July. Electron counts may recover to become high at diurnal maxima on days 2 to 4 (3rd to 5th July), though may be suppressed again in the case of the arrival of any CME or HSS from CH96/-. Thereafter, Day 4 could see a substantial lowering in electron accounts, with the possible arrival of the HSS from the much larger CH97/+. Electron fluence values, though initially above the Active ($1\text{e}8$ integrated pfu) threshold, are expected to fall below by the start of the 3rd July and very likely remain below over the following days due to CME and/or HSS impacts.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	Yes	100	20	5	5
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 2: GOES16 Electron flux and MOSWOC REFM output.

